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HICKEY — PRACTICAL APPLICATION OF
AUSCULTATORY PERCUSSION BY CONTINUOUS VIBRATION

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THE PRACTICAL APPLICATION OF AUSCULTATORY PERCUSSION BY CONTINUOUS VIBRATION.

BY

JOHN P. HICKEY, M. D.
A. A. Surgeon, U. S. Public
Health Service.
Formerly of the Department of Public Health
City and County of San Francisco
San Francisco, Cal.

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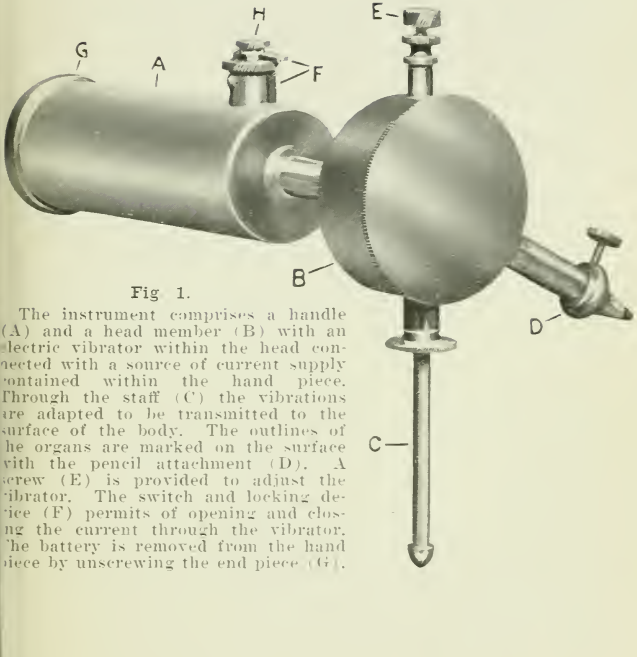

Fig 1.

The instrument comprises a handle (A) and a head member (B) with an electric vibrator within the head connected with a source of current supply contained within the hand piece. Through the staff (C) the vibrations are adapted to be transmitted to the surface of the body. The outlines of the organs are marked on the surface with the pencil attachment (D). A screw (E) is provided to adjust the vibrator. The switch and locking device (F) permits of opening and closing the current through the vibrator. The battery is removed from the hand piece by unscrewing the end piece (G).

THE PRACTICAL APPLICATION OF AUSCULTATORY PERCUSSION BY CONTINUOUS VIBRATION.

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Vibratory auscultatory percussion differs but slightly from the method of auscultatory percussion, that was first described in 1840. The claims for the newer method, as will be seen, are not in excess of those advocated at that time, with the possible exception that the vibratory technic will detect impairments of pulmonary resonance, though possible but difficult by the older method. With the exceptions of certain limitations to be mentioned later, the method of auscultatory percussion, using continuous vibration, instead of blows being struck with the fingers or hammer, will be found to possess many advantages over other methods, its relative value to diagnostics being all that a more precise method of percussion may stand for.

Several photographs have been introduced, which will illustrate the technic, and at the same time show its applicability to varied conditions.

The method of auscultatory percussion as described by Camman and Clark (1840) had the following claims made for it:

> "1st That the heart can be measured in all but its anterior-posterior diameters, under most, perhaps all circumstances of health and disease, with hardly less exactness than we should be able to do if the organ were exposed before us.

2nd That the outlines of the liver can be traced with much greater certainty than by ordinary percussion in circumstances of health; and to circumscribe it in many conditions of disease in which ordinary percussion is not applicable.

3rd That the dimensions of the spleen can be ascertained in circumstances that baffle ordinary percussion.

4th That by it we can mark the superior, inferior, and external limits of the kidneys. Ascites presents no obstacle to the measurements of these organs; and from enlarged spleen the left kidney is easily distinguished. * * *''

In recent times writers have commented favorably regarding auscultatory percussion, as may be seen from the following quotations taken from standard text books on diagnosis:

"* * * auscultatory percussion is a valuable means of defining the exact outline of a dull area, as an aneurism, or tumor within the chest, or determining the limits of organs even of similar nature. * * *''

—*Musser.*

"* * * It is a sufficiently useful method to deserve a much wider use than it has yet attained. Its particular application is to determine the outlines of either solid or air-containing organs.''

—*Butler.*

This refers to the practicing of auscultatory percussion by digital means, or with a hammer.

The vibrator imparts vibrations that are continuous, following each other in rapid succession, permitting of forcing the underlying structures into vibration. It is to this fact that the possibility of outlining the heart borders with emphysematous lung tissue intervening is attributed, and also the determining of increases in density of lung tissue.

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It is not advisable to adhere too closely to set rules in describing the technic, as more or less latitude will have to be left to individual users, to vary the technic as physical conditions may require; the most to be expected being a general description of the application of the fundamental principle

Rather than displacing ordinary percussion,

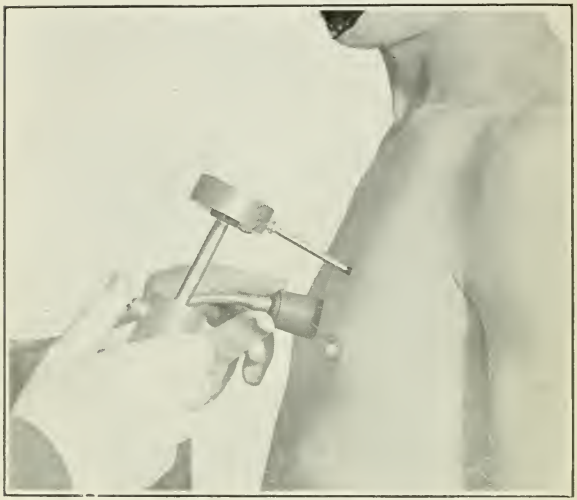

Fig. 2.

the vibratory method will be of assistance to beginners, by teaching them to recognize the various degrees of impairment of resonance by first pointing it out and also aid those with defective hearing.

With a few changes, the technic for ordinary auscultatory percussion may be applied to the

vibratory method, which consists in placing the chest piece of the stethoscope upon the surface overlying the organ to be delimited, holding it in position with the left hand (See Fig. 2), while the vibrator is manipulated with the right hand (See Figs. 2 and 3).

One begins by placing the staff of the vibrator upon the surface, at some distance outside of the presumable limits of the organ, and moving it in the direction of the stethoscope (See Fig. 4).

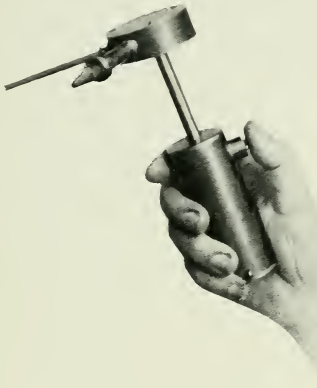

Fig. 3.
Showing the manner of holding the vibrator.

When the border of the organ is attained, there is a noticeable increase in intensity, an elevation in pitch, and perhaps a slight alteration in the quality of the sound. The vibrator is to be moved along lines, that are carried radially from various points encircling the organ, to the stethoscope as a centre. If the exact spot on each line, at which an alteration in sound occurs,

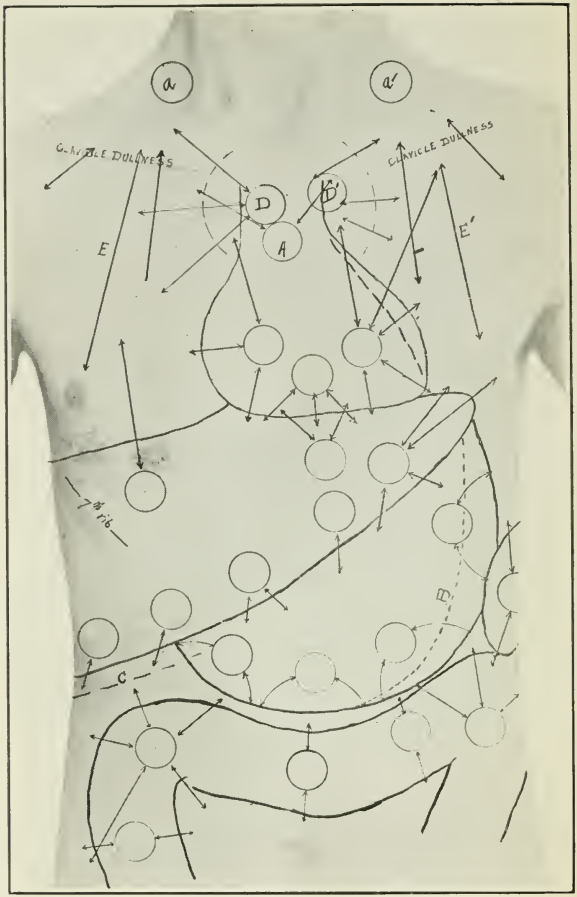

Fig. 4.

THE GENERAL SCHEME FOR USING THE VIBRATOR.
(Diagramatic)
See foot of page 7 for description of technic.

is marked, and these marks subsequently joined by a continuous line, an outline of the organ will have been obtained. The double-pointed arrows shown in the accompanying figures, indicate that the vibrator is to be moved in two directions: the arrows with the broken shafts, indicating that the vibrator staff, is to be applied lightly upon the surface.

The technic will have to be varied somewhat, depending on whether an organ is deep, or superficially situated, and when dealing with the lungs, as to whether the infiltration is of greater or lesser degree.

The varying of the technic will have to do with the amount of pressure applied through the staff, upon the surface of the body, being analagous to the varying of the force of the blow struck, with the fingers, when practicing ordinary percussion. The lighter the staff of the vibrator is applied upon the surface, the more definite will be the results.

As a rule, sufficient pressure should be exerted to make a faint sound audible through the stethoscope, with the staff placed somewhat outside the area of dullness.

The vibrator is to be moved in the directions indicated by the arrows; the chest piece of the stethoscope being placed over the circles.

a, a′ placement of the stethoscope when examining the lungs.

D, D′ When mapping out mediastinal "dulness."

E, E′ Along these lines, as a rule, changes in pulmonary densities will usually be found. When the vibrator is placed over the clavicle there will be produced a distinct increase in the intensity of the sound, due to the clavicle, while immediately below this point, should there be no infiltration, there will be only a faint sound heard while the staff of the vibrator is moved slowly and lightly applied upon the surface.

B The usual position of the line found when delimiting the greater curvature of the stomach.

C The lower limit of liver "dulness" made out during arrested deep inspiration with the body bent backward.

The vibrator may be manipulated in several ways as the physical conditions may suggest:

(1) Place the stethoscope over an organ, and move the vibrator from various points toward the stethoscope.

(2) Place the stethoscope over the organ, and move the staff of the vibrator *from* the stethoscope, toward the periphery of the structure.

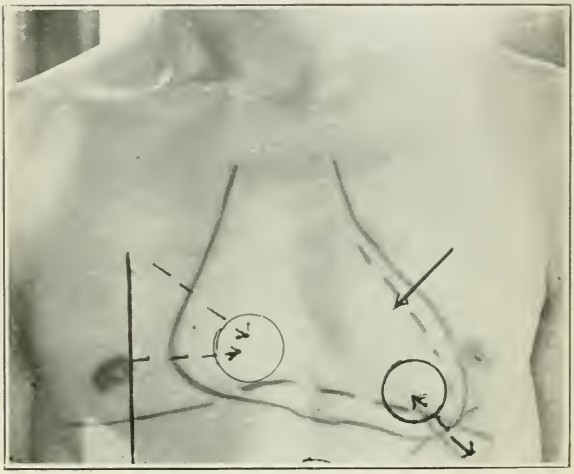

Fig. 5.
Tricuspid incompetency.

A combination of these two maneuvers will be found most satisfactory.

The position of the border may be marked on the surface, by a slight supinating of the hand, which will bring the dermatograph in position for marking (See Fig. 1).

By keeping the stethoscope placed over an organ, in a position as far away as possible, from that border which is being approached by the vibrator, the propagating of surface vibrations will be minimized, permitting of sharp contrast in the change of sound, when the border of

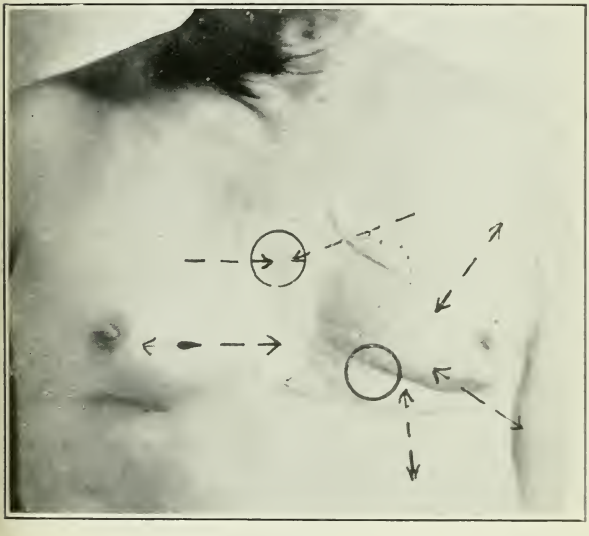

Fig. 6.

Hypertrophy of the left ventricle. Note the line as it passes over the summit of the breast.

the organ has been reached. For example, place the chest piece of the stethoscope over the apex of the heart, and move the vibrator, very lightly applied upon the surface, along the 4th, right, interspace, in the direction of the corresponding border of the heart: although the sound as heard

through the stethoscope will be of diminished intensity, the right border of the organ at this point may be definitely determined (See Figs. 5 and 6). Where an underlying organ is firmly in contact with the wall, the precautions mentioned, in reference to the pressure exerted through the staff of the vibrator, may to a great extent be disregarded; it is in instances where the organ is more or less loosely in contact with the wall, so to speak, or where the normal convexity of the viscus tends to prevent its border coming in direct contact with the wall, that requires the pressure to be regulated; under these circumstances the vibrations are transmitted through the intervening tissues, the lack of homogeniety of which will alter the intensity of the sound.

When the border of an organ has been reached, the vibrations which were being propagated along the surface, will be augmented, due to the increase of density, brought about by the underlying viscus, which will also increase the amplitude of vibration, with a consequent increase in the intensity of the sound as heard through the stethoscope, the intensity varying as the square of the amplitude of vibration, and further upon the density of the medium at the point where the vibrations are imparted to it; the intensity also varying inversely as the square of the distance from the source.

It is the more or less abrupt increase or decrease in the intensity of the sound, depending as to whether the vibrator is moved in a direction toward or from the stethoscope, that determines the location of a border.

It has been determined by experiment, that

with the staff of the vibrator pressed firmly upon the surface, the surface propagating of the vibrations will extend to a point approximately five centimeters distant from the staff; by making light pressure, the distance may be decreased to less than one centimeter.

The question will naturally suggest itself as to how underlying bone will influence the technic. Bone will, of course, better favor the propagating of vibration than other tissues, but though the initial sound will be of greater intensity when the border of an organ is reached by the vibrator for the reasons stated above, the intensity of the sound will be correspondingly increased. For example: move the vibrator along the 4th, left intercostal space, determining the left border of the heart; then place the stethoscope over the 4th left rib, moving the vibrator, very lightly applied, along the same structure; note that the change in the intensity of the sound will take place on a line corresponding with point outlined over the interspace; this can be made out more distinctly if the chest piece of the stethoscope has a soft rubber facing. By varying the degree of pressure as exerted by the staff, it will be *always* possible to "tune out" disturbance that may be caused by the presence of bone.

HEART.

Place the stethoscope above and to the inner side of the apex, so that it surely rests over the heart. See Figs. 3, 4, 5 and 6. Move the staff of the vibrator from all sides toward the stethoscope, and vice versa, marking with the dematograph the point where the sound markedly increases in intensity, and proceeding precisely as with ordinary auscultatory percussion, carrying

out the details of the technic as described above. The stethoscope is to be shifted to various parts of the cardiac area; figure 4 will show graphically the procedure; the arrows indicating the direction in which the vibrator is to be moved, while the circles show the placements of the stethoscope.

It will be noted that the area of dulness* will be greater than that obtained by ordinary percussion, under similar circumstances, due to the vibrator reacting more sensitively over areas where there are tissues intervening, or where there is convexity of the viscus.

It is especially important that the staff of the vibrator be applied lightly upon the surface while it is passing over the breast or well-developed pectorals.

In delimiting the lower portion of the left border of the heart and its apex in females, especially if there is enlargement of the organ to the left, some difficulty may be met with, due to the presence of the mammary gland. This may be overcome by displacing the breast either upward or to the left.

At times our ingenuity will be taxed endeavoring to map out the extreme apex of the heart, due to it being held away from the chest wall. In such cases make very light pressure with the staff (see Figs. 4 and 6), moving it to and fro over the assumed location, which assumption is based on following the line of the left border downward. We always seek an object where it is most likely to be found. This is not to be associated with mental suggestion, but rather

* The word "dulness" is used synonymously with "increase in density."

mental appreciation of the conditions with which we are likely to be dealing.

It may require some little practice to map out the right border of the heart under normal circumstances. It is advisable to practice outlining the cardio-hepatic triangle, which will give opportunity to differentiate cardiac from hepatic dulness. The staff of the vibrator *is to be applied lightly* when delimiting the right border of the heart.

SPLEEN.

It is well to know the exact position and relations of a normal spleen, also the minimum degree of allowable variation in the position and size of the organ under normal circumstances, and its relations to contiguous portions of the stomach, colon, and kidney.

To obtain accurate results the stomach and colon should be empty.

In carrying out the examination the patient may be sitting or standing, with the left arm across the back or if recumbent, he should be partly turned to the right, with the left arm over the head.

When dealing with those in whom there is laxity of the abdominal walls, it will be found that the recumbent posture favors the spleen gravitating toward the centre and posterior regions of the abdominal cavity,—away from the lateral wall. This condition is often met with in multipara.

If a pillow be placed partially beneath the right side, in such a manner that when the patient is turned slightly to the right, it will

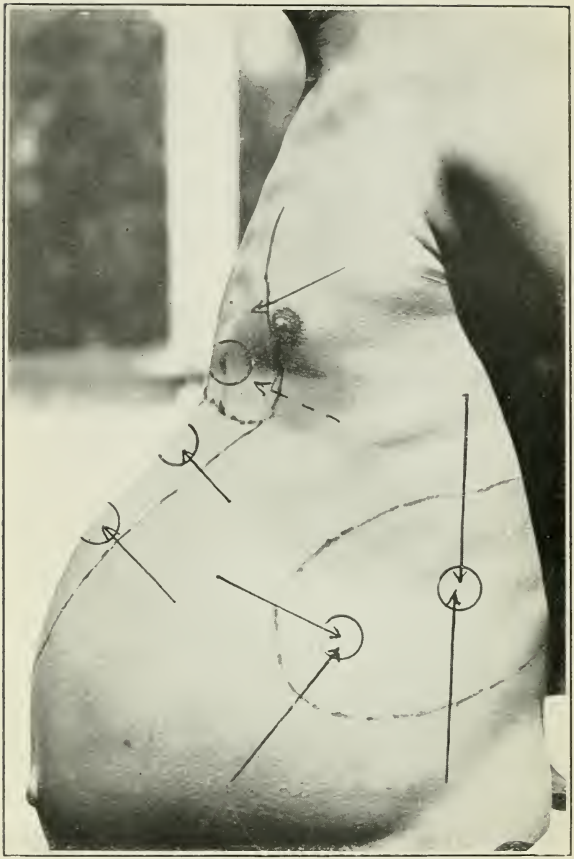

Fig. 7.

Schistosomiasis (*S. japonica*). Note the enlargement of the liver and spleen.

cause pressure to be made upward and inward, favoring the delimiting of the organ.

ANTERIOR LIMIT: Place the chest piece of the stethoscope over the ninth intercostal space on the posterior or mid-axillary lines. The staff of the vibrator is to be applied lightly upon the surface of the body, and moved to and fro in the directions of the arrows as shown in Figures 4 and 7.

It will be found that when the staff of the vibrator is traversing that part of the abdominal wall that is in direct contact with the stomach, should the latter contain food, there will be an increase of the intensity of the sound, and for this reason the stomach should be empty.

UPPER LIMIT: Move the staff of the vibrator downward, in the direction of the normal position of the upper border of the organ, as shown in Figures 4, 7 and 8.

The position of the superior border under normal conditions, will be found at the level of the ninth rib. With but few exceptions, the spleen, especially in bacterial and protozoal diseases, enlarges symetrically; therefore the determining of the upper and lower limits along the posterior axillary line will give valuable information as to whether the organ is enlarged.

LOWER LIMIT: Move the vibrator in an upward direction along the posterior axillary line.

POSTERIOR LIMIT: Move the vibrator in the direction of the arrows shown in Figure 8.

KIDNEYS.

Determine the positions of the 11th, thoracic and 3rd lumbar spines, and between their levels,

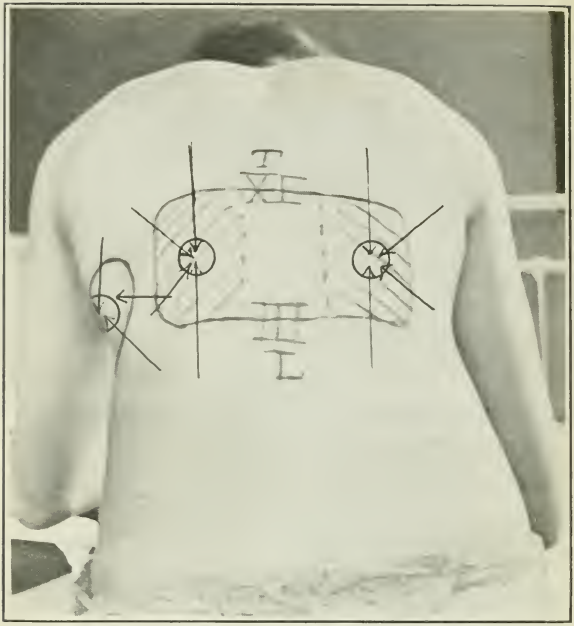

Fig. 8.
Technic of outlining the kidneys.

one inch from the median line on each side, place the stethoscope, moving the vibrator from various points toward it, as shown in Figure 8.

LIVER.

Figure 4 will show the general scheme for placing the stethoscope and moving the vibrator.

RIGHT LOBE: Place the stethoscope over the following interspaces:

Mamillary line in the 7th
Mid-axillary line in the 8th
Scapular line in the 10th

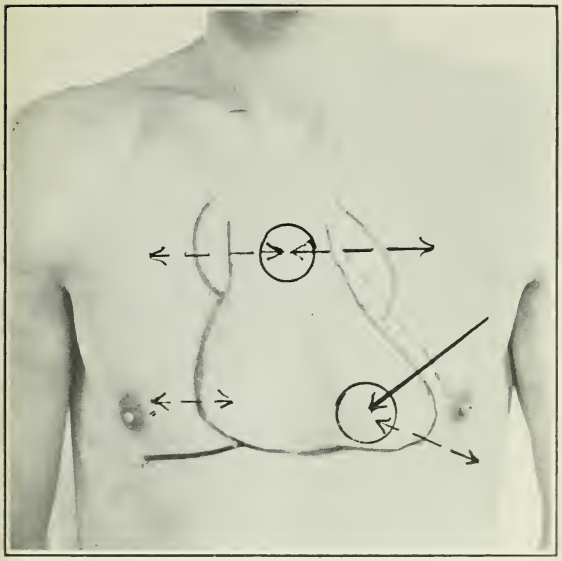

Fig. 9.

Tracing of a tumor of the mediastinum which at autopsy proved to be a sarcoma.

LEFT LOBE: The stethoscope is to be placed over the epigatrium, immediately below the xiphoid appendix.

Move the vibrator from various points toward the stethoscope, as in ordinary auscultatory percussion.

When delimiting the lower border, it is well to have the patient bend backward, during arrested inspiration, causing the liver to lie against the anterior abdominal wall, thus facilitating to a considerable extent the determining of the lower limits of the organ. At the lower border,

the contrast in the change of sound will not be as sharp as at the upper, due to the flaccidity of the surrounding structures.

STOMACH.

To obtain the most satisfactory results, it is advisable that the intestines be empty till immediately before the examination, then have the patient drink eight ounces of water. This will aid in differentiating the lower limits of the stomach from the colon.

The stethoscope is to be placed over the 6th or 7th rib in the left mamillary line, or in the angle between the xiphoid appendix and the left costal margin, and begin by moving the vibrator from points well without the normal gastric area, toward the stethoscope, which is to be shifted into various positions as indicated by Figure 4.

The area of dulness, as will be described on the abdominal wall, may not be as extensive as the true anatomical limits of the organ, due to its convexity (See dotted line Fig. 4).

COLON.

By placing the stethoscope along the course of the colon, and moving the vibrator to and from its position, reliable information will be obtained as to the size and position of the viscus. See Fig. 4.

ANEURISM OF THE ARCH OF THE AORTA AND MEDIASTINAL TUMORS.

The stethoscope should be placed over the upper part of the sternum, and the staff of the vibrator moved toward it, along 2nd and 3rd intercostal spaces (see Fig. 4); an area of dul-

ness giving a rounded outline, especially if its convexity is to the right, will probably be due to aneurism. Tumors of the mediastinum will give atypical areas of dulness (See Fig. 9).

It is important to remember that a light application of the staff is to be made when delimiting structures lying beneath the breast bone.

GYNECOLOGY AND OBSTETRICS.

It will be unnecessary here to enter into a description of the technic, as the application of the principle of vibratory percussion will as far as technic is concerned be the same as for ordinary auscultatory percussion.

LUNGS.

The vibratory method of percussion is a more rapid and accurate means of detecting areas of

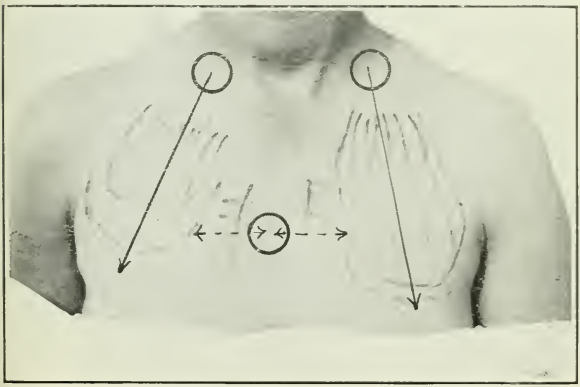

Fig. 10.

Advanced pulmonary tuberculosis. The broken lines indicating the lower limits of increased density obtained during arrested deep inspiration. The short horizontal lines indicate infiltrations at the roots of the lungs.

changes in density of lung tissue, having the advantage that outside noise will not interfere so as to make a satisfactory conclusion impossible; especially is this the case when many are in the room where the examinations are being made.

It is possible to rapidly survey a number of individuals in a short time, and set those aside who show indications of abnormalities for further observation. In this manner cases will be detected that otherwise would have required a very highly trained ear, and the most favorable surroundings to detect by ordinary digital per-

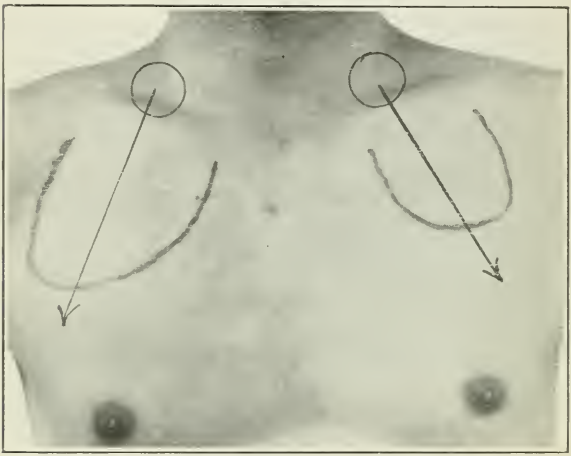

Fig. 11.

Increase in density of the upper lobes, which condition was impossible to make out by ordinary percussion. It is not certain whether the infiltration is due to a previous tuberculous lesion or to infestation by the *paragonimus ringeri*. The individual being from a region where the latter condition is endemic. There were no tubercle bacilli or ova of the trematode found in the sputum.

Fig. 12.

Radiograph of individual shown in Fig. 11.

"* * * Plate taken posterior-anteriorly shows the lung fields throughout showing exceedingly plain the ramifications of the bronchial trunks. There is along the trunks some small areas of slightly increased density, which suggest the possibility of there having been at some remote time an active disseminated process. This condition is quite noticeable in the infraclavicular regions. The hilus shadows appear about normal. Under the fluoroscopic screen the diaphragms are seen symmetrical, the diaphragmatic excursion is good and the apices light brilliantly. This man has had to all appearances an extensive tuberculous infection at some time which I believe to be of the peribronchial type. However, I do not believe there is at present an active process, nor has there been one recently."

cussion, and in not a few instances by auscultation.

In examining the lungs for the existence of tuberculosis, the stethoscope is to be placed in the supraclavicular spaces, and one or two man-

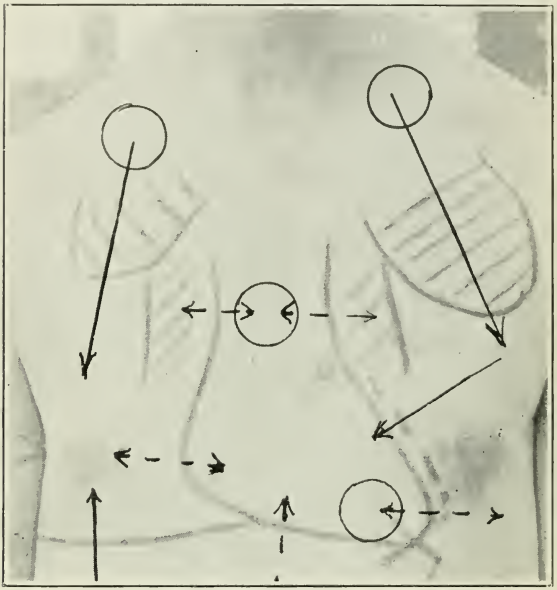

Fig. 13.

Arrested tuberculosis with infiltration at the roots of the lungs. Ordinary percussion indicated a very slight impairment in resonance. Clinical course negative.

euvers of the vibrator made use of. The arrows shown in Fig. 4 will indicate the direction in which the vibrator is to be moved, the circles indicating the placement of the stethoscope.

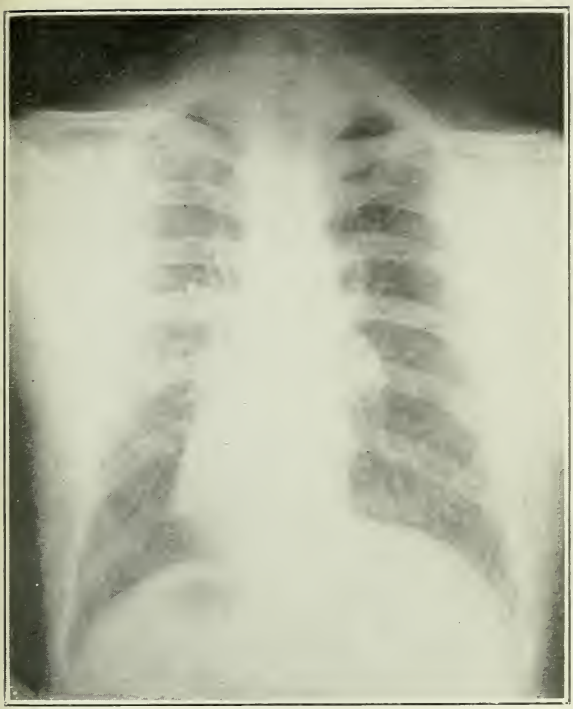

Fig. 14.

Radiograph of individual shown in Fig. 13.

" * * * Plate taken posterior-anteriorly shows the lung fields throughout showing the ramifications of the bronchial trunks exceedingly plain. This condition is seen very markedly in the left side from the root of the lung into its adjacent fields and specially so toward the infraclavicular region; on the right side this same condition exists and is most noticeable at the root of the lung. Along some of the trunks there are small areas of increased density which suggest some old healed foci. The diaphragmatic excursion is good on both sides, the right diaphragm appears symmetrical, the left diaphragm under the fluroscope appears to be adherent and unsymmetrical. The left apex does not seem to light as brilliantly as the right. Apparently there has been an extensive tubercular infection which is undergoing healing."

Under normal conditions, there will always be an increase in the intensity of the sound when the staff of the vibrator is in contact with the tissues overlying the clavicles. This increase of the intensity of the sound is to be disregarded.

The sound as heard through the stethoscope will be of varying degrees of intensity, depending on the amount of infiltration present. It is advisable in order to become familiar with the indentity of the sounds under normal and abnormal conditions, to use the vibrator technic in a case known to be afflicted with tuberculosis, which fact being easily demonstrable by digital percussion; a unilateral infection being preferable.

This will give opportunity for study of the sides of the chest comparatively. At the limits of the dull area, especially if the process be active, where it shades off into normal resonance, an idea will be had of the quality of the sound, that is to be expected over areas of minor degrees of infiltrations. Fig. 10.

Vibratory percussion will not determine etiologic factors, nor will it differentiate an active from an inactive process; it will also be impossible to determine hyper-resonance or tympany by its means.

The intensity of the sound will depend on the extent of the structural changes that have taken place, and as to whether they are deep or superficially situated. Where there is a diffuse though slight bilateral lesion of inactive tuberculous peribronchial lymphangitis, with little or no invasion of the parenchyma, and particularly when there is no pleural involvement, the recognition of this condition of peribronchial in-

Fig. 15.

A technic for determining apical dulness by comparison which will be found useful in suitable cases, i. e., before retraction of the apex has taken place. The vibrator is to be placed over the 7th cervical or 1st thoracic vertebrae, and during continuous vibrating of the vibrator the chest piece of the vibrator is to be placed alternately in each supra-clavicular space to determine if there is an increase in density which will be manifested by an increase in the intensity of the sound as heard through the stethoscope.

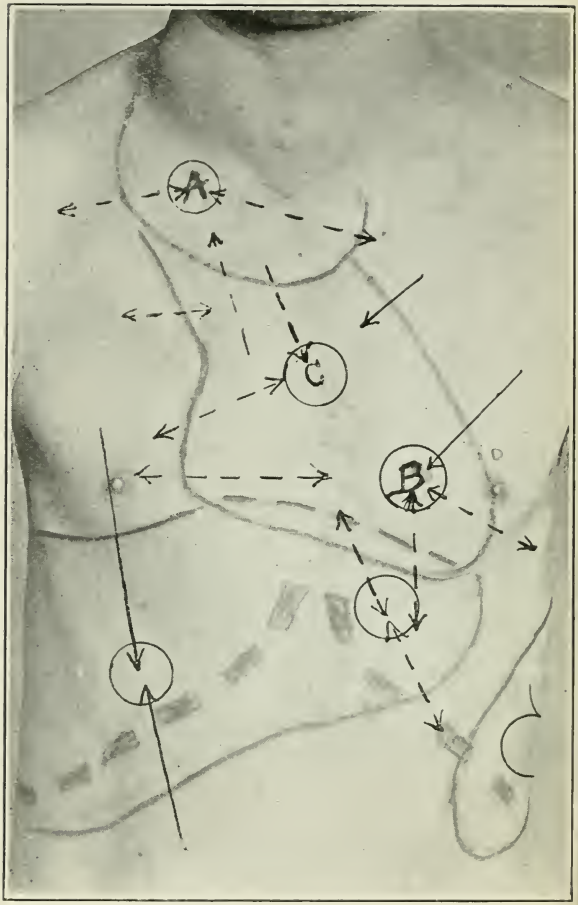

Fig. 16.

For description see foot of page 27.

filtration, by this or any other auscultatory method, may be exceedingly difficult.

Although an area of increased density may not be at the periphery of the lung, it will nevertheless favor the propagating of vibrations, thus altering the intensity of the normal sound, to a degree depending on the size of the infiltrated area.

Assuming that a tuberculous process may begin at the root of the lungs, and ascends along the trunks of the bronchi; in which instance the lesion is very likely to be deeply situated, and presenting conditions that, as far as percussion is concerned, would be difficult if not impossible to overcome by digital percussion. By the vibratory method of percussion, it is possible to force into vibration a greater area of tissue, which under normal conditions will produce sounds having a quality the standard of which may be readily established; should there be a parenchymatous lesion of moderate extent though deeply situated, its presence will also increase the density of the tissues immediately surround-

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A clinical tracing (the circles and arrows being added to the photograph later) of a new growth affecting the right lobe of the thyroid body and extending downward toward the base of the heart. There is evidence of pressure being exerted on the superior vena cava with the establishing of a collateral circulation which is manifested by changes in the superficial veins of the abdomen and thorax, and by the reversed direction of the blood stream within them (The dilated veins are not well shown in the photograph).

With the chestpiece of the stethoscope placed over circle "A" the limits of the tumor are not outlined so extensively, this being undoubtedly due to the fact that only that portion of the tumor that is in contact with the chest wall is outlined, while its lower portion extends downward behind the great vessels and away from the chest wall.

The lower limit of the growth is determined by placing the stethoscope over circle "B," when it will be found that its "dulness" will be continuous with that of the heart.

Attention is also called to the enlargement of the liver and spleen.

ing the lesion, owing to the secondary inflammatory processes, whether their nature is limited to exudation of leucocytes and serum, or to a proliferation of connective tissue elements. In acute and sub-acute bronchitis the impairment of resonance due to increased secretion may be readily recognized by vibratory percussion.

Frequently vibratory percussion will indicate a tuberculous lesion, which may show only a very slight X-ray shadow, if at all. There may be no other physical signs, though the case will otherwise run a typical course, with the tubercle bacilli being present in the sputum.

What has heretofore been said regarding the technic when dealing with the solid viscera also applies when dealing with intra-thoracic infiltrations and collections of fluids, i. e., by placing the stethoscope over the areas that are usually involved, and moving the vibrator along radial lines toward it.

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